PROGRESSIVE POWER OPHTHALMIC LENS

This is a continuation of application, Ser. No. 027,813, filed Apr. 6, 1979 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to lenses for eyeglasses, and particularly to bi or multi focal lenses.

Known lenses of this type include a surface having an upper distance-vision portion or distance portion FT, a lower near-vision portion or near portion NT and a varying or progressional or transitional region PB between the two portions. The near portion is sometimes called the "add".

In the upper distance portion FT the surface contains a far reference point B_F and exhibits predetermined average distance-vision surface refractive powers $\overline{D}_F$. The lower near portion NT, containing a near reference point B_N in accordance with DIN 58208, has predetermined average near-vision surface refractive powers $\overline{D}_N$. The transitional region PB has average surface refractive powers $\overline{D}_P$ which effect a smooth transition from the distance portion FT to the near portion NT. The surface is divided into a temporal portion and a nasal portion by a principal meridian M which forms an umbilical point line.

An object of the invention is to provide a surface for such a lens for eyeglasses which has the following properties:

(a) a large, almost spherical, distance-vision portion in which the effect varies, at most, ±0.1 diopters,

(b) a large, also almost spherical, near-vision portion, in which the effect varies, at most, ±0.1 diopters,

(c) a progression region whose peripheral surface astigmatism is small and whose average effect in the horizontal direction exhibits only a small gradient and whose length along the principal meridian is approximately 18 mm.

The terms used in this application, the prior art, the objects of the invention, features of the invention, the advantages of these features, and details of preferred embodiments can be best understood from the following description when read in light of the drawings:

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. **1** is a diagram illustrating the lens surface with a circular boundary and a center point 0.

FIG. **2** is a graph illustrating the surface refracted power along the principal meridian of FIG. **1**.

FIG. **3** is a diagram illustrating the surface of FIG. **1**.

FIGS. **3A** and **3B** are drawings illustrating a lens embodying the invention.

FIG. **4** is a graph of characteristics of surfaces embodying the invention.

FIG. **5** is a graph of other characteristics of surfaces embodying the invention.

FIG. **6** is a graph of other characteristics of surfaces embodying the invention.

FIGS. *7a, 7b, 7c,* and *7d* are diagrams comparing known lens surfaces in FIGS. *7a, 7b, 7c* with a surface, shown in FIG. *7d* embodying the invention.

FIGS. *8a, 8b, 8c,* and *8d* are diagrams comparing three known lens surfaces, shown in FIGS. *8a, 8b,* and *8c,* with a surface embodying the invention, shown in *8d.*

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a lens surface with a circular boundary and a center point 0. In an upper distance-vision, or distance, portion FT containing a far reference point B_F in accordance with German industrial standard DIN 58208 this surface has predetermined average distance portion surface refractive powers $\overline{D}_F$. In a lower near-vision, or near, portion NT containing a near reference point B_N in accordance with German industrial standard DIN 58208 this surface has predetermined average near portion surface refractive powers $\overline{D}_N$. In a varying or transitional or progression region PB located between the distance portion FT and the near portion NT the surface has average surface refractive powers $\overline{D}_P$ which effect a smooth transition from the distance portion FT to the near portion NT. The surface is divided into a temporal portion and a nasal portion by a principal meridian M which forms an umbilical line, or umbilical point line.

At the bottom of FIG. **1** toward the transitional region PB, the distance portion FT is limited by a line of constant average surface refractive powers $\overline{D}_{F0}$; at the top of the progression region P_B, the near portion NT is limited by a line of constant average surface refractive powers $\overline{D}_{N0}$.

The amount of the increase of the surface power between the far reference point B_F and the near reference point B_N is denoted by A. Accordingly, $A=\overline{D}_N(B)_N-\overline{D}_F(B_F)$.

A surface power D is defined as usual, namely by

$$D=\frac{n'-n}{r}\ [dpt] \tag{1}$$

wherein

n=refractive index in front of the surface (air),

n''=refractive index behind the surface (the lens material),

r=radius of curvature at the respective surface point in the respective tangential direction.

The surface astigmatism is also defined as usual, namely by

$$\Delta D=(n'-n)\left(\frac{1}{r_1}-\frac{1}{r_2}\right) \tag{2}$$

wherein

r_1, r_2=principal radii of curvature in the respective surface points,

n=refractive index in front of the surface (air),

n'=refractive index behind the surface (lens material).

The average surface refractive power is also defined as usual, namely by

$$\overline{D}=\tfrac{1}{2}\left(\frac{1}{r_1}+\frac{1}{r_2}\right)(n'-1) \tag{3}$$

FIG. **2** shows an example for the curve of the surface refractive power along the principal meridian M. FIG. **2** shows the difference of the surface powers between B_N and B_F which equals A.